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## Drowning in Alaskan Waters

### SYNOPSIS

**Objective.** To enumerate drowning fatalities in Alaska in order to identify risk factors and areas for intervention.

**Methods.** Information from death certificates, state troopers' reports, and medical examiner reports were abstracted and analyzed. Rates were calculated using 1990 census figures as denominator data.

**Results.** There were 542 drowning fatalities in Alaska for the years 1988 to 1992. The 20–29 age group had the highest frequency and rate of drownings. The incidence rate for the state was 20 drownings per 100,000 population per year, almost 10 times higher than the overall U.S. rate of 2.11 per 100,000 per year. Incidence rates were highest among adolescent males (10–19), young adult males (20–29), Alaska Natives, and rural residents. Alaska Native males, ages 30–39 averaged 159 drownings per 100,000 per year, the highest drowning rates in the state.

**Conclusions.** Drowning is a major public health concern in Alaska. People who fish commercially and young Native males are groups at high risk for drowning. Intervention efforts should be concentrated on these two populations.

**D**rowning is the second leading cause of injury death in Alaska.<sup>1</sup> In the United States as a whole, drowning ranks fourth among unintentional injury deaths after motor vehicle-related deaths, poisonings, and falls, based on data from the National Center for Health Statistics. Drowning is the second leading cause of injury death among children and young adults ages 1 to 24 years.<sup>2</sup>

Alaska has the highest drowning rate of any state. During the years 1984 to 1990, the United States had an age-adjusted drowning rate of 2.11 per 100,000 population per year, while Alaska experienced an age-adjusted rate of 11.03 per 100,000 per year, more than five times higher than the national rate.<sup>2</sup> A previous study of causes of death in Alaska for 1980–1989 found an average drowning rate of 22 per 100,000 per year.<sup>1</sup> For this same time period, drowning was the leading cause of injury death among Alaska Natives, with an age-adjusted drowning rate of 51.9 per 100,000 per year.<sup>1</sup> Additionally, for the years 1990 to 1992, drowning was the leading cause of occupational fatalities in Alaska, according to statistics maintained by the Alaska Field Station of the National

Institute for Occupational Safety and Health.

Despite these high rates and the potential to learn about a serious national problem by studying the worst-case state, there has not been a comprehensive drowning study for the state of Alaska since 1979. In 1993, the Alaska Area Native Health Service of the Indian Health Service and the Alaska Field Station, Division of Safety Research, National Institute for Occupational Safety and Health, undertook a collaborative study to enumerate drowning fatalities in Alaska. The goal of the study was to identify potential risk factors and possible interventions.

Alaska encompasses 586,412 square miles, is twice the size of Texas, and has more coastline than the rest of the continental United States combined—6640 miles, including islands. However, the state ranks 47th among the 50 states in total road miles. Alaska has more than 3000 rivers and three million lakes, but only 13,485 miles of roads. Only five of the state's urban centers are connected by road.<sup>3</sup> Alaskans, especially in the outlying communities, use rivers and coastal waterways as highways both in the summer (by boat) and winter (as ice roads) for travel, commercial purposes, subsistence (including hunting, wood gathering, and berry picking), and recreation.

## Methods

Drowning fatalities were identified by reviewing death certificates for the state of Alaska for the years 1988 through 1992. Demographic data, cause of death (including E-code when available), and circumstances surrounding the incident (including location, activity, use of safety equipment) were recorded from certificates that cited drowning, immersion injury, or hypothermia with immersion as a cause of death.

To validate the resultant drowning database, we compared it with a computer listing obtained from the Alaska Bureau of Vital Statistics. The listing was sorted according to the following International Classification of Diseases (ICD) External Cause Codes (E-codes):

- E 830 accident to watercraft causing submersion [for example, injury resulting from vessel overturning, sinking, or burning]
- E 832 other accidental submersion or drowning in water transport accidents
- E 910 accidental drowning and submersion
- E 954 suicide by submersion [drowning]
- E 964 assault by submersion [drowning]
- E 984 submersion [drowning], undetermined whether accidentally or purposely inflicted.

We also compared our drowning database for 1988–1992 with the Alaska Occupational Injury Surveillance System (AOISS) database that records occupational fatalities occurring in the state. AOISS collects information from a variety of agencies, including the

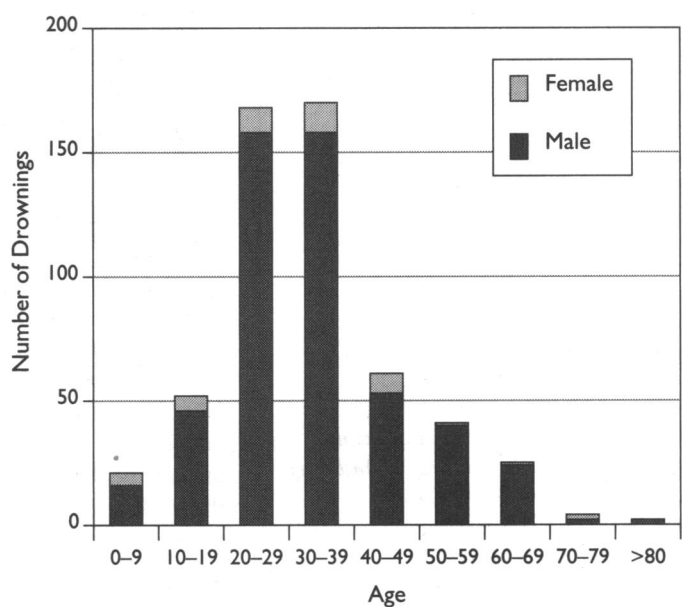
United States Coast Guard, the state of Alaska's Department of Epidemiology, and the Bureau of Vital Statistics. AOISS includes data from 1990 on, so only the years 1990, 1991, and 1992 could be validated. Forty-four percent (108) of the occupational fatalities recorded in AOISS for the years 1990 to 1992 were drownings or presumptive drownings.

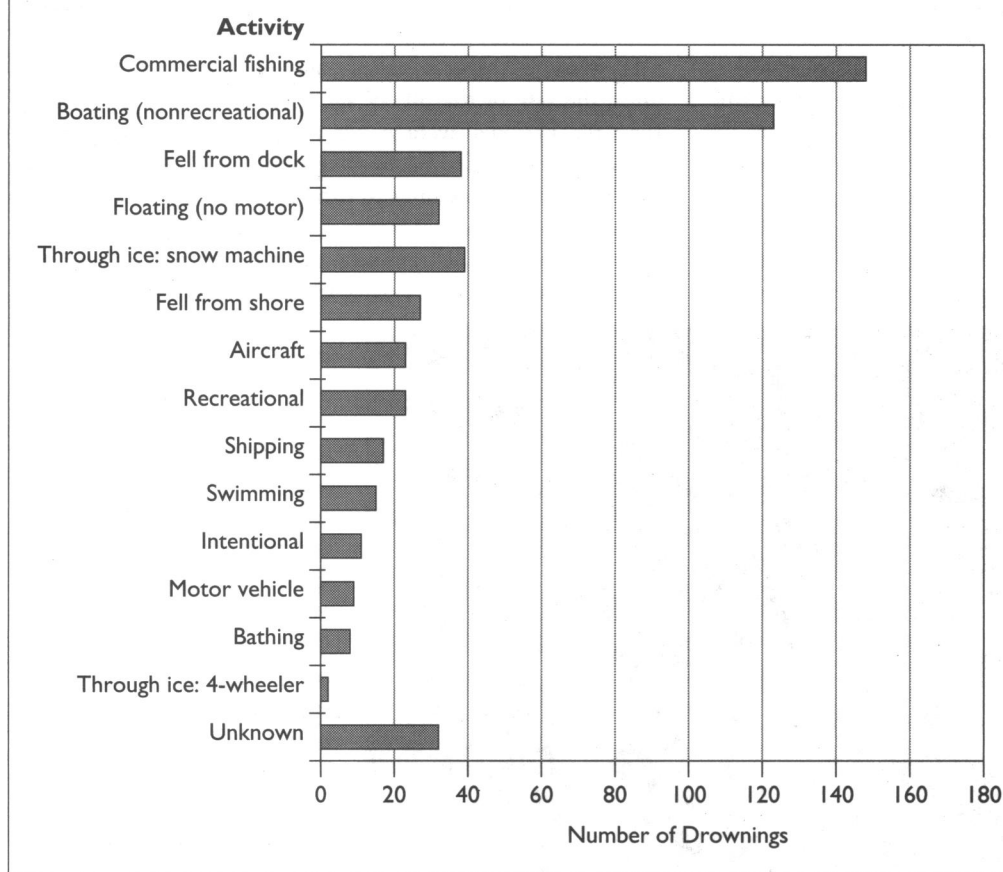
After the data were abstracted, the fatalities were classified by geographic location, whether the injury occurred while working, occupation of those injured at work, and activity at time of incident. Fatality rates were calculated by age group, racial categories, and gender. Denominators for the incidence rates were based on the 1990 Alaska population.<sup>4</sup> Medical examiners' and public safety officers' reports were used to assess use of personal flotation devices (PFDs) and toxicologic evidence of alcohol or drug consumption.

## Results

A total of 542 fatal drownings occurred in Alaskan waters from 1988 through 1992. Of these, 60% occurred during the months of May through September, while 221 (40%) occurred from October through April. The frequency of drownings varied by age and sex (see Figure 1), with the highest frequency and the highest rate in the 20–29 age group. This group accounted for 168 (31%) of the total drownings, equivalent to a rate of 35.5 drownings per 100,000 per year. The 30–39 age group also had 168 drownings (31% of the total), representing a rate of 28.6 drownings per 100,000 per year. During the five-year period, there were 497 male drowning victims (92%) and 45 females (8%). The greatest number of victims, 148 (27%) were fishing commercially when they drowned; 124 (23%) were

**Figure 1. Drownings by age and gender, Alaska, 1988–1992 (N=542)**



**Figure 2. Drownings by activity, Alaska, 1988–1992 (N=542)**

using boats for nonrecreational purposes, and 38 (7%) deaths were attributed to falls from docks (Figure 2).

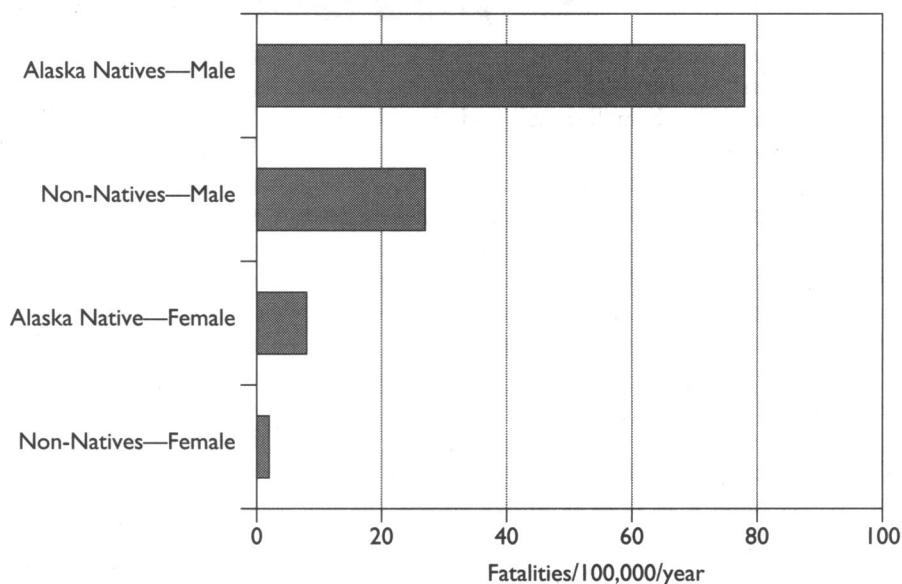
For the five-year period, we calculated the average annual drowning rate for the state as 20 per 100,000 population per year. Of the victims, 335 (62%) were white, 186 (34%) were Alaskan Native, and 21 (4%) were neither white nor Alaskan Native. The drowning rate for Alaska Natives was 43 per 100,000 per year. The combined rate for all non-Natives was 15 per 100,000 per year.

Alaska Native males (78 per 100,000 per year) and females (8 per 100,000 per year) had fatal drowning rates almost three times those for non-Native males (27 per 100,000 per year) and non-Native females (2 per

100,000 per year) (Figure 3). Alaska Native males ages 10 to 19 had a drowning rate of 74 per 100,000 per year, those ages 20 to 29 had a rate of 140 per 100,000 per year, and those in the 30 to 39 age group had a rate of 159 per 100,000 per year.

Of the drowning victims, 326 (60%) drowned in salt water and 199 (37%) drowned in fresh inland waters. The other 3% drowned in bathtubs and hot tubs. Thirty-eight percent of the drownings were work-related, 72% of these among commercial fishing industry workers.

Information on PFD use was available on fewer than 10% of the death certificates. Medical examiner and state trooper reports were requested for all of the drownings. These reports contained information on PFD use and on alcohol and drug

**Figure 3. Drowning rates for Alaska Natives and non-Natives by gender, Alaska, 1988–1992**

NOTE: Source of denominator data was Alaska Department of Labor. *Alaska Population Overview—1990 Census & Estimates*. 1991.

involvement. Of the 542 total drownings detected by our surveillance, 349 drownings were not presumptive; a body was recovered and a medical examiner's report should have been filed. Of these, 186 medical examiner reports were located, with all of these victims having been tested for alcohol: 113 (61%) had detectable blood alcohol. In 94 (51%) of these people the level was above 100 milligrams per deciliter (mg/dl). Alcohol testing was completed on 54% of the Alaska Native victims and on 53% of the non-Native victims. Of the 100 Alaska Native decedents tested, 49 (49%) had detectable blood alcohol levels of more than 100 mg/dl for the 86 non-Natives tested, 41 (52%) had a blood alcohol level of more than 100 mg/dl. In addition, 162 victims were tested for illicit drugs: 18 (11%) victims had detectable cannabinoids, one victim had detectable cocaine metabolites, one had detectable amphetamine metabolites, and another had detectable opiate and cannabinoid metabolites. Thirteen (8%) victims had both detectable alcohol and one of the drug metabolites.

We divided the drowning incidents into census boroughs and calculated the drowning rate for each borough. The geographic region with the highest drowning rate was the Lake-Peninsula Borough in Southwest Alaska that includes the villages of Iliamna, Nondalton, and Chignik. The drowning rate for this area was 160 per 100,000 per year. The Aleutians East Borough had a rate of 110 per 100,000 per year, and the Dillingham Borough and the Aleutians West Borough each had a rate of 90 per 100,000 per year.

In validating the drowning database with the AOISS database, we detected seven (1%) additional presumptive drownings that were unaccounted for in the death certificate database. We notified the Alaska Bureau of Vital Statistics of these missing certificates, and the missing cases were added to our drowning database for analysis.

## Discussion

The incidence of drowning is extremely high among Alaska Natives residing in rural areas and among Alaskan commercial fishing workers, likely reflecting the very high exposure to water hazards in these populations.

For the study period, the Alaskan drowning rate was approximately ten times the national incidence rate of 2.11 drownings per 100,000 population per year, and the Alaska

Native population had a rate 20 times higher than the national rate.<sup>1</sup> The drowning rate of Alaska Native males was three times as high as the combined rate for non-Native males. The rate ratio of Alaska Native males (78.1 per 100,000 per year) to non-Native males (26.7 per 100,000 per year) was 2.9:1. Alaska Native males of all ages had very high rates: the rate of the 30–39 age group was 35 times higher than the national average, for the 20–29 group it was 66 times higher, and for the 10–19 group it was 75 times higher.

To combat drownings in rural native villages, the Alaska Area Native Health Service has developed programs in which flotation coats are sold at or below cost. There are currently seven active floatcoat sales programs located in

hub communities across the state. More than 3500 floatcoats were sold in the first three years (1991 to 1993) of the program. The Yukon/Kuskokwim Health Corporation in southwest Alaska has been the most active of the seven programs, accounting for more than 70% of the floatcoat sales. From October 1992 to September 1993, at least 16 people in this region attested that their floatcoats saved their lives.<sup>5</sup>

Blood alcohol concentration (BAC) studies in decedents must be regarded with some caution. Blood alcohol levels in corpses can be exaggerated by alcohol produced by the decomposition process. One study showed a

difference of 18% in those testing positive for alcohol depending on length of time in the water 29% positive BACs among victims who had been submerged six hours or less and 47% positive BACs among victims who had been submerged up to 12 hours.<sup>6</sup> Whether parallel differences would be observed in arctic and subarctic conditions and cold waters is unknown because fermentation is a temperature-dependent process.

The problem of alcohol interacting with cold water hazards to cause drowning is by no means limited to Alaska. A review of 36 studies on drownings from 1947 to 1986 found that 21% to 47% of those who drowned had positive BACs.<sup>7</sup> There are several reasons to suspect alcohol as a contributing factor in drownings. Alcohol may hamper the ability to avoid dangerous circumstances. The warm sensation that alcohol creates may make some victims misjudge their heat loss, resulting in hypothermia. The risk for caloric labyrinthitis, an inner ear disturbance that disorients the swimmer, may be increased by intoxication.<sup>6</sup> Alcohol may also affect sober people since they may drown as a result of

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an intoxicated person's actions.

Commercial fishing contributes significantly to the national and regional economies. In 1989, the United States harvested one-fifth the world's total of fish. Alaska accounts for nearly 50% by volume and almost 40% by value of the total U.S. harvest. In the 1980s, Alaska's largest private employer was the fishing industry.<sup>8</sup>

U.S. Coast Guard casualty data show that the west coast of the United States accounted for the greatest share of total vessel losses and fatalities. Alaska ranked second in the nation in total vessel losses and fatalities.<sup>8</sup>

Strategies are currently being developed to reduce commercial fishing fatalities in Alaska by correcting instability problems, such as overloading, that cause vessels to sink or capsize and by using PFDs and "man overboard" alarms to prevent workers from drowning when falling overboard. It has been previously demonstrated that when fishers who drowned or were presumed to have drowned were compared with those who survived incidents in which at least one other fisher drowned, 63% of those wearing PFDs survived but only 12% of those not wearing PFDs survived.<sup>9</sup>

Nationally, the hazards of commercial fishing have also captured the attention of Congress, which enacted the Commercial Fishing Industry Vessel Safety Act (CFIVSA, P.L. 100-424) of 1988. These safety measures were implemented between 1990 and 1993. Two of the present authors analyzed U.S. Coast Guard statistics for Alaskan commercial fishing vessel casualties from 1991 to 1994.<sup>10</sup>

The number of vessel casualties (vessels lost) has remained relatively constant, as has the number of people on board (number at risk), while remarkable progress has been made in the case-fatality rate in these vessel casualties, which has dropped from 24% in 1991 to 2% in 1994. This impressive progress in reducing mortality has occurred primarily by keeping seamen who have evacuated capsized or sinking vessels afloat and warm (using immersion suits and life rafts) and being able to locate them readily, via emergency position indicating radio beacons (EPIRB's) all of which are required by the CFIVSA.<sup>10</sup>

Some possible sources of error and limitations of our data are worth noting. Out-of-state deaths of Alaskan residents were not included in this study. However, residents of other states who drowned in Alaska, usually commercial fishing industry workers from out of state, were included. Since the denominators used to calculate rates were based on Alaskan 1990 census data, this inclusion could have resulted in artificially inflating drowning rates in the West Aleutian and East Aleutian districts, where most of these workers died. Death certificates reveal very little about circumstances surrounding the drownings.

Of the 542 people who died by drowning, 148 (27%) were commercially fishing at the time they drowned.

Because most commercial fishing activities occur on salt water, more people drowned in salt water than in fresh water. Alaska Natives were most often using boats for transportation or subsistence or other non-recreational activities when they drowned. The National Institute for Occupational Safety and Health Alaska Field Station is focusing drowning prevention efforts on the commercial fishing industry—specifically on the acceptance and wearing of PFDs and the possible utility of man-overboard alarms. An ongoing surveillance system has been set up by the Alaska Field Station in collaboration with the Alaska Area Native Health Service and the Alaska Bureau of Vital Statistics to collect information on all drownings in Alaska regardless of occupational status. This database is linked to the AOISS database mentioned above.

Drowning continues to be a major public health problem in the United States and particularly in Alaska. In Alaska, further surveillance and detailed investigation of fatal and nonfatal immersion events via hospital records and medical examiners' and state troopers' reports are essential to increase information on risk factors such as alcohol and PFD usage. Studies focusing on specific geographic regions would permit more detailed analysis of the problem. Such information is critical for developing and targeting intervention efforts to reduce drownings.

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